

**INDIANA DEPARTMENT OF TRANSPORTATION
MATERIALS AND TESTS DIVISION**

**BINDER CONTENT BY IGNITION
ITM No. 586-02T**

1.0 SCOPE.

- 1.1** This is the test method to determine binder content of HMA by ignition in a furnace. The aggregate remaining after ignition may be used to evaluate the gradation of the aggregate in the mixture.
- 1.2** The values stated in either acceptable English or SI Metric units are to be regarded separately as standard, as appropriate for a specification with which this ITM is used. Within the text, SI Metric units are shown in parenthesis. The values in each system may not be exact equivalents; therefore each system shall be used independent of the other, without combining values in any way.
- 1.3** This procedure may involve hazardous materials, operations and equipment. This ITM does not purport to address all of the safety problems associated with the ITM's use. The ITM user's responsibility is to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.0 REFERENCES.

2.1 AASHTO STANDARDS.

T 30 Mechanical Analysis of Extracted Aggregate
M 231 Weighing Devices Used in the Testing of Materials

2.2 ITM STANDARDS.

572 Drying HMA Mixture
580 Sampling HMA
587 Reducing HMA Samples to Testing Size
802 Random Sampling

2.3 OTHER.

Ignition Oven Operations Manual

3.0 TERMINOLOGY.

- 3.1 Terms and Abbreviations.** Definitions for terms and abbreviations shall be in accordance with the Department's Standard Specifications, Section 101.

4.0 SIGNIFICANCE AND USE.

- 4.1 This procedure is used to determine the binder content of HMA by ignition in a furnace.
- 4.2 The aggregate remaining after ignition may be used to evaluate the gradation of the aggregate in the mixture in accordance with AASHTO T 30.
- 4.3 The binder content of the HMA is based on the percent weight (mass) loss of a sample. The weight (mass) loss is comprised of a loss of binder and a loss of aggregate.
- 4.4 A mix calibration factor shall be determined for each HMA mixture in a specific oven to account for any loss of aggregate during ignition and any variability between ovens that may occur.
- 4.5 Each mix calibration factor is unique to an individual ignition oven and not transferable.
- 4.6 The binder content and aggregate gradation may be evaluated for payment of the HMA.

5.0 APPARATUS.

- 5.1 **Balance.** A device used to determine mass in accordance with AASHTO M 231, class G₂.
- 5.2 **Catch Pan.** A wide, shallow open vessel made from heat resistant material, the depth of which is less than one-fifth the least lateral dimension. The catch pan is designed to hold the sample baskets and catch binder or aggregate that falls from the sample.
- 5.3 **Sample Container.** A container for holding or carrying materials.
- 5.4 **Guards.** Brackets made of heat resistant material designed to protect the sample baskets and keep the sample baskets in fixed positions.
- 5.5 **Ignition Oven.** The oven shall be a forced air ignition furnace capable of maintaining a temperature of 1100 ± 9 °F (578 ± 5 °C). The oven shall be equipped with an internal balance, thermally isolated from the oven chamber, accurate to 0.1 g over the range of use. The oven chamber shall accommodate a sample size of 3500 g. The oven shall have a door designed to refuse entry during the ignition test. The oven shall be equipped to minimize emissions during the ignition test. The oven shall be vented into a hood or to the outside. The oven shall have no significant odors and no smoke escaping into the laboratory during the ignition test. The oven shall have a fan able to pull air through the furnace to expedite the test. The oven shall have an automatic shut off that can be set at 0.01% of the sample weight (mass). The oven shall provide an alarm when a test is complete.

- 5.6 Ignition Oven Basket Assembly.** The assembly consists of: the catch pan, multiple sample baskets, lid and guards.
- 5.7 Lab Oven.** An enclosed compartment supplied with heat used for warming and drying specimens and capable of reaching at least $250 \pm 9^{\circ}\text{F}$ ($120 \pm 5^{\circ}\text{C}$).
- 5.8 Protective Cage.** An enclosure made of bars or wire used to cover the hot sample baskets and prevent accidental contact.
- 5.9 Sample Basket.** A box made of heat resistant screen mesh with openings of approximately 0.1 in. (2.5 mm). Multiple baskets shall be designed to be nested one on top of the other. The baskets shall be large enough to hold up to 3500 ± 5 g of HMA.
- 5.10 Safety Equipment.** Safety Glasses or Face Shield, High Temperature Gloves and Long Sleeve Jacket as required.
- 5.11 Miscellaneous Equipment.** Bowls, spatulas, pans and wire brushes as required.

6.0 CALIBRATION PROCEDURE.

- 6.1** The contractor shall prepare all calibration samples as shown below.
- 6.2** Obtain aggregate material and binder for the HMA mixture as shown on the DMF/JMF.
- 6.3** Determine the weight (mass) required for the calibration samples. The samples shall not be more than 400 g greater than the minimum recommended specimen size. Samples of HMA 37.5 mm shall be split equally and tested separately. Test results shall be averaged.

Mixture Designation Size,	Minimum Recommended Specimen Weight (Mass), g
4.75 mm	1200
9.5 mm	1200
12.5 mm	1500
19.0 mm, C19.0	2000
25.0 mm, C25.0	3000
37.5 mm	4000

- 6.4** The contractor shall prepare all replicate calibration samples of the HMA mixture in accordance with the mix design.
- 6.5** The first sample prepared for each mixture shall be used as a butter mix to coat the mixing bowl and shall be discarded after mixing.
- 6.6** Determine and record the weight (mass) required for each aggregate fraction and binder based on the percentages in the DMF/JMF.

- 6.7** Heat the binder to the temperature recommended by the manufacturer. Combine and mix the aggregate fractions until a uniform blend is obtained. Stir in the binder until the aggregate is uniformly coated.
- 6.8** Select 1000°F (538 °C) or 900 °F (482 °C) for the calibration test. If dolomite is used in the mix 800°F (427°C) may be used for the calibration test.
- 6.9** Send four calibration samples and the information at 6.6 and 6.8 to the District where the road samples will be tested.
- 6.10** Determine the calibration factor for a specific oven for a specific HMA mixture as follows:
 - 6.10.1** Test at least two of the calibration samples in accordance with 8.0. If dolomite is used in the mix in accordance with 6.8, test all four of the calibration samples.
 - 6.10.2** Record the calibrated binder content to the nearest 0.01 percent for each calibration sample.
 - 6.10.3** Calculate the sample calibration factor as the difference between the calibrated binder content and the design binder content for each sample.
 - 6.10.4** If dolomite is used in the mix in accordance with 6.8 follow 6.10.4.c) otherwise follow 6.10.4.a) and 6.10.4.b).
 - a)** If the difference between the two sample calibration factors is less than 0.15 percent then the mean of the two sample calibration factors may be determined and reported as the mix calibration factor.
 - b)** If the difference between the two calibration factors is more than 0.15 percent, two additional calibration samples shall be tested. Discard the highest and lowest sample calibration factors from the four values, then determine and report the mean of the remaining two sample calibration factors as the mix calibration factor.
 - c)** Determine and report the mean of the four sample calibration factors as the mix calibration factor.

7.0 SAMPLING PROCEDURE. The HMA shall be sampled in accordance with ITM 580 using a sample bucket as defined at 5.3 as the container.

8.0 BINDER CONTENT PROCEDURE.

- 8.1** Ensure the stability threshold value of the ignition oven is set at 0.01 percent weight (mass) loss for three minutes. Record the stability threshold value as set.
- 8.2** Program the oven to provide an unabbreviated ticket.
- 8.3** Preheat the ignition oven to the test temperature. Record the test temperature.

- 8.4** Record the mix calibration factor in percent for the mixture at the specified temperature.
- 8.5** Dry the specimen to constant weight (mass) in accordance with ITM 572.
- 8.6** Weigh the specimen and determine if it meets the size requirements specified at 6.3.
- 8.7** If needed, reduce the specimen to the correct size in accordance with ITM 587.
- 8.8** Measure and record the weight (mass) of the ignition oven basket assembly using the external balance.
- 8.9** Place the bottom basket inside the catch pan on top of the scale and tare out the scale.
- 8.10** Place the first half of the sample in the bottom basket and record the weight (mass). Spread the HMA evenly over the bottom of the basket ensuring the material is not in contact with the sides of the basket.
- 8.11** Place the top basket on the bottom basket and tare out the scale.
- 8.12** Place the second half of the sample in the top basket and record the weight (mass). Spread the HMA evenly over the bottom of the basket ensuring the material is not in contact with the sides of the basket.
- 8.13** Repeat 8.12 and 8.13 for additional baskets as required.
- 8.14** Complete the ignition oven basket assembly by attaching the lid and guards.
- 8.15** Measure and record the weight (mass) of the ignition oven basket assembly with the dry sample using the external balance.
- 8.16** Calculate the weight (mass) in grams of the dry sample using this formula.

$$W1 = W2 - W3$$

Where:

W1 = Weight (mass) of the dry sample in grams

W2 = Weight (mass) of ignition oven basket assembly with dry sample in grams

W3 = Weight (mass) of ignition oven basket assembly

- 8.17** Enter the mix calibration factor and the weight (mass) in grams of the dry sample into the ignition oven computer in accordance with the Ignition Oven Operations Manual.
- 8.18** Place the ignition oven basket assembly and dry sample in the ignition oven in accordance with the Ignition Oven Operation Manual.
- 8.19** Burn the dry sample in the ignition oven until the oven shuts off automatically.

- 8.20** Remove the ignition oven basket assembly and burned sample from the ignition oven. Place the assembly on a firm heat resistant surface. Cover the assembly with a protective cage and allow it to cool to about room temperature.
- 8.21** Remove the unabbreviated ignition oven ticket from the ignition oven console. Record the calibrated asphalt content to the nearest 0.01%.
- 8.22** Determine and record the weight (mass) of the ignition oven basket assembly and burned aggregate.

9.0 AGGREGATE GRADATION PROCEDURE.

- 9.1** Determine the starting weight (mass) of aggregate for T 30. Follow 9.1.1 if the decant is started on the aggregate in the ignition oven baskets. Follow 9.1.2 if the decant is started on the aggregate in a new container.
 - 9.1.1** Determine and record the starting weight (mass) of aggregate for sieve analysis when decanting is started with the burned aggregate in the ignition oven baskets.
 - a)** Determine and record the weight (mass) of the ignition oven basket assembly and the burned aggregate using the external scale.
 - b)** Calculate the starting weight (mass) of the burned aggregate for decanting and then sieve analysis.

$$W1 = W2 - W3$$

Where:

W1 = Weight (mass) of burned aggregate in grams

W2 = Weight (mass) of ignition oven basket assembly and burned aggregate in grams

W3 = Weight (mass) of ignition oven basket assembly

- 9.1.2** Determine and record the starting weight (mass) of aggregate for sieve analysis when decanting is started with the burned aggregate in a new container.
 - a)** Determine and record the weight (mass) of a new container.
 - b)** Carefully dump the burned aggregate into the new container. Clean the baskets with a brush to collect all loose material.
 - c)** Determine and record the weight (mass) of the new container and burned aggregate.
 - d)** Calculate the starting weight (mass) of the burned aggregate for the decant and then sieve analysis.

$$W1 = W2 - W3$$

Where:

W1 = Weight (mass) of burned aggregate in grams

W2 = Weight (mass) of new container and burned aggregate in grams

W3 = Weight (mass) of new container

- 9.2** Determine the gradation of the aggregate in accordance with AASHTO T 30.
- 9.3** The wet wash shall be conducted on the aggregate placed into a container or on the ignition oven basket assembly with the aggregate. The latter procedure should be used when air drafts in the lab may contribute to the loss of fine material. All water from the wet wash shall be collected and run over the required sieves.

10.0 REPORT.

- 10.1** Report the test temperature, mix calibration factor and the absorption factor for mix calibration tests.
- 10.2** Report the calibrated binder content, test temperature, the mix calibration factor, the temperature correction factor and the oven number for mix acceptance tests. Attach the full, unabbreviated ignition oven ticket to the report.
- 10.3** Report the weight (mass) retained on each sieve and the percent passing on each sieve, for aggregate gradation tests.